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Codes and Standards applied in Chinese NPP designs



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1 Introduction of NPPs in China

China is now rapidly developping its nuclear power construction, up to 2020, China will have more than 40 power reactors under operation.



In China, we have now Gen-I, Gen-II NPPs under operation.

Gen-I: Qinshan 300MWe, domestic prototype PWR

Gen-II: Qinshan Phase II 2X600MWe, domestic PWR

Daya Bay 2X900MWe, French PWR

LingAo 2X900MWe, French PWR

Tianwan 2X1000MWe, Russian PWR

Qinshan Phase III 2X700MWe, CANDU

The above NPPs mainly apply different foreign codes and standards.



The domestically-designed Gen-II+ NPPs are being built.

LingAo phase II 2X900MWe, improved on the basis of LingAo, similar designs being applied in the Hongyanhe, Fuqing, Linde and Yangjiang sites etc.

Qinshan Phase II extension 2X600MWe, improved on the basis of Qinshan Phase II, similar designs to be applied in the Hainan site.

The above NPPs apply combination of foreign and domestic codes and standards.



And the Gen-III NPPs are imported and being built.

AP1000: 2X1100MWe at Sanmen *ASME*
2X1100MWe at Haiyang

EPR: 4X1600MWe at Taishan - *RCC-M*

They apply US and Europe codes and standards respectively.



2 Domestic Gen-II+ designs

The key improvements of the domestic Gen-II+ designs are as follows:

- use of more advanced FA
- use of digital I&C system
- use of more advanced SG
- adaptation of the RPV material
- adaptations of some safety systems
- enhance of severe accident countermeasures
- etc.



All these are related to NSSS and choice of codes and standards is very important.

NPIC has designed the Reactor coolant system or NSSS for all the domestic Gen-II+ NPPs.

We establish a set of principles for application of the codes and standards with approval of NNSA.



3 Principles of codes and standards application

The principles for application of the codes and standards in the domestic Gen-II+ NPPs:

- a. All the currently effective laws, regulations, codes and guides on the NPP safety and environment protection issued by Chinese government must be observed



- b. For the design and construction, the French RCC standards shall be applied with necessary modifications according to IAEA or other international codes and standards.
- c. For the components purchased in foreign countries, the applied codes and standards shall be at least equivalent to the French RCCs.



- d. If there are any inconsistency between the applied codes and standards, the ones more conservative to safety shall be used.
- e. The versions of the applied codes and standards shall be defined by the designer.

A lot of detailed work on the analyses of the different codes and standards have been done according to the above principles.



Up to now, all the designs have been successfully performed according to the principles.



4 Typical Gen-II+ codes and standards list

The following is an example of the typical Gen-II+ codes and standards list.

For each specific NPP , the list is slightly different according to the purchaser's requirement or due to some other reasons.



A. Laws and Codes

A.1 Chinese laws

including laws on the environment protection, water pollution prevention, radioactive pollution prevention, ocean pollution prevention, nuclear material management, nuclear accident emergency management etc.



A.2 HAF codes (NNSA)

including NPP QA safety regulations, site choosing regulations, design safety regulations, operation safety regulations, NPP safety licensing regulations, NPP operator licensing regulations, radioactive waste management regulations, nuclear pressure-retaining equipment management regulations etc.



A.3 Foreign codes

US 10CFRs for reference.

B. Guides

B.1 HAD guides (NNSA)

including detailed requirements corresponding to the HAFs.

B.2 Foreign guides

US NRC RGs for reference.



C. Standards

C.1 Standards to be observed

C.1.1 Nuclear fuel and systems

RCC-P (Rev.91+95Modifications)

RCC-C (Rev.98)

GB18871-2002 Basic standards of the radioactive protection and radioactive sources safety



C.1.2 Mechanical equipment

RCC-M(Rev.2000+2002 modifications)

RSEM (Rev.97)

C.1.3 I&C and electrical systems

RCC-E (Rev.1993)

IEC60880-1986 NPP safety system computer softwares

IEC60880.2-2000 NPP safety-important computer softwares

C.1.4 Fire protection

RCC-I (Rev.83)

C.1.5 Civil works

RCC-G (Rev.1986)



C.2 Standards for reference

including Chinese national standards GBs, some Chinese industrial standards EJs, US ANSIs, ASMEs, ASTMs, MSS, etc.



5 Work on establishment of domestic codes and standards

A lot of discussions are being held on establishment of a series of domestic codes and standards in China, mainly by CNNC and CGNPC etc.



6Remarks

- a. Chinese designers are capable of effectively using different codes and standards to successfully design the Gen-II+ NPPs.
- b. The Chinese own codes and standards will be established in future time.



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THANKS !